ESI
ECOLOGICAL SERVICES, INC.

E5675

P.O. Box 12146, Charlotte, North Carolina 28220
Phone (704) 522-1111
Fax (704) 521-8004

November 18, 1994

Ms. Janis D. McHargue
North Carolina Department of Health,
Environment and Natural Resources
8028 North Point Blvd., Suite 100
Winston-Salem, North Carolina 27106

Subject: Hydrogeologic Considerations Response
(justifications in response to DEHNR November 7, 1994 letter)

Dear Ms. McHargue:

Ecological Services, Inc. (ESI), on behalf of Mr. Larry Griffin, offer the following justifications in responce to the noted hydrogeologic considerations outlined in your November 7, 1994 letter.

Long-term seasonal high water table levels -

Upon the submission of the ESI September 1, 1994 Report of Hydrological Assessment Addendum, ESI had compiled groundwater gauging data from February 10, 1994, May 5, 1994, and May 27, 1994. Additional gauging data of select monitoring wells was collected during in-situ permeability testing on November 9, 1994. The compilation of this data represents gauging data collected in the first, second, and fourth quarters of this year. Although gauging data was not collected during the third quarter, ESI considers this period to be a representative trend for seasonal ground water fluctuations. ESI has constructed a hydrograph of depth to water measurements for groundwater monitoring wells MW-7, MW-8, and MW-10 from gauging data collected during the previously mentioned gauging events (Figure 1). In May, wells MW-7 and MW-8 showed an increase in water table recharge which is typical for this time of year. Fourth quarter monitoring (November) indicates a seasonal low for well MW-7. The maximum change in depth to water levels within these wells is 1.65 feet.

In-situ determination of hydraulic conductivity in bedrock -

In order to better characterize the hydraulic conductivity within the bedrock zone at the subject site, ESI conducted a permeability test on monitoring well MW-7. The Bouwer and Rice (1976) Method was used, assuming a partially penetrating screen and a radius which included the sand pack. The hydraulic conductivity calculated for monitoring well MW-7 is (9.42×10^{-6} cm/sec). Appendix A contains a graph of the in-situ permeability test and the calculations used.

In-situ determination of hydraulic conductivity in partially weathered rock -

In order to better characterize the hydraulic conductivity within the partially weathered rock zone at the subject site, ESI conducted additional permeability tests on monitoring wells MW-9 and MW-10. The Bouwer and Rice (1976) Method was used, assuming a partially penetrating screen and a radius which includes the sand pack. The hydraulic conductivity calculated for monitoring wells MW-9 and MW-10 are (2.64×10^{-6} cm/sec) and (7.92×10^{-5} cm/sec) respectively. The higher hydraulic conductivity value calculated for MW-10 is thought to be due to the close proximity of the water holding pond located approximately 20 feet to the west. Considering this additional recharge source, this well could be considered not representative of the in-situ conditions across the remaining portion of the landfill. Appendix A contains graphs of the in-situ permeability tests and the calculations used.

Lithologic logs and well construction data for MW-2, MW-3, MW-4, and MW-5 -

Lithologic logs and well construction data for monitoring wells MW-2, MW-3, MW-4, and MW-5 are included in Appendix B of this letter report.

Monitoring wells MW-2 and MW-3 -

Due to the close proximity of monitoring well MW-2 to the on-site water holding pond (within 5 feet), ESI suggests that the combination of monitoring wells MW-3 and MW-10 be used to monitor groundwater characteristics in the area between the lowest part of the pit and Cane Creek. Although monitoring well MW-2 is intact, it may not present data indicative of groundwater which has moved through the landfill area, due to recharge to the well from the holding pond.

Cross Sections -

All geologic cross sections previously submitted in ESI's September 1, 1994 Report of Hydrogeologic Assessment Addendum were constructed utilizing May 26, 1994 topographic information; therefore, changes to the cross-sections are not warranted.

ESI trusts the information provided will meet the hydrogeologic requirements set forth in the DEHNR November 7, 1994 Technical Review Letter. Please do not hesitate to contact us if you have any questions or require additional information.

Sincerely,
ECOLOGICAL SERVICES, INC.

Paul A. Banks
Project Geologist

Ronald C. Gilkerson
Vice President

FIGURE

	February	May 5th	May 27th	November
MW-7	51.36	50.93	50.91	51.5
MW-8	18.73	18.42	18.92	18.52
MW-9	11.85	12.2	11.01	10.55

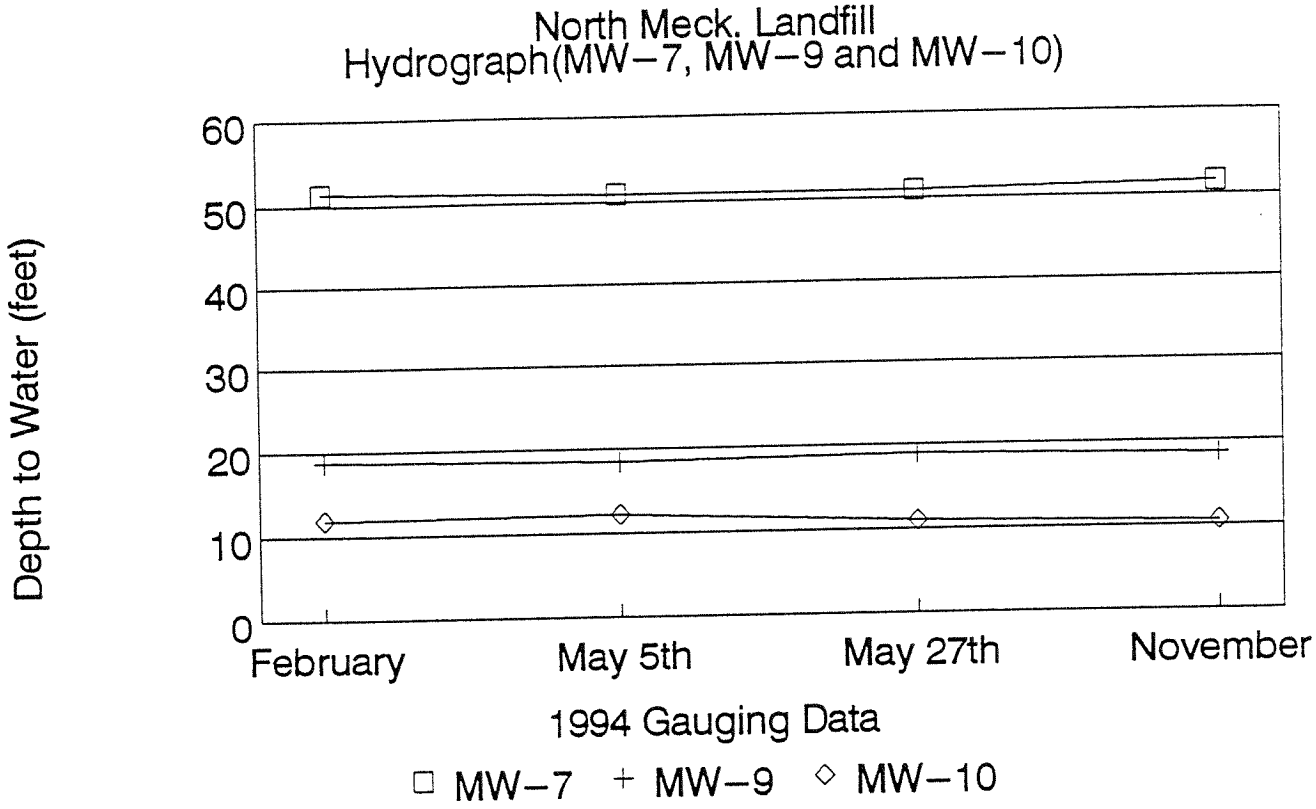


FIGURE 1

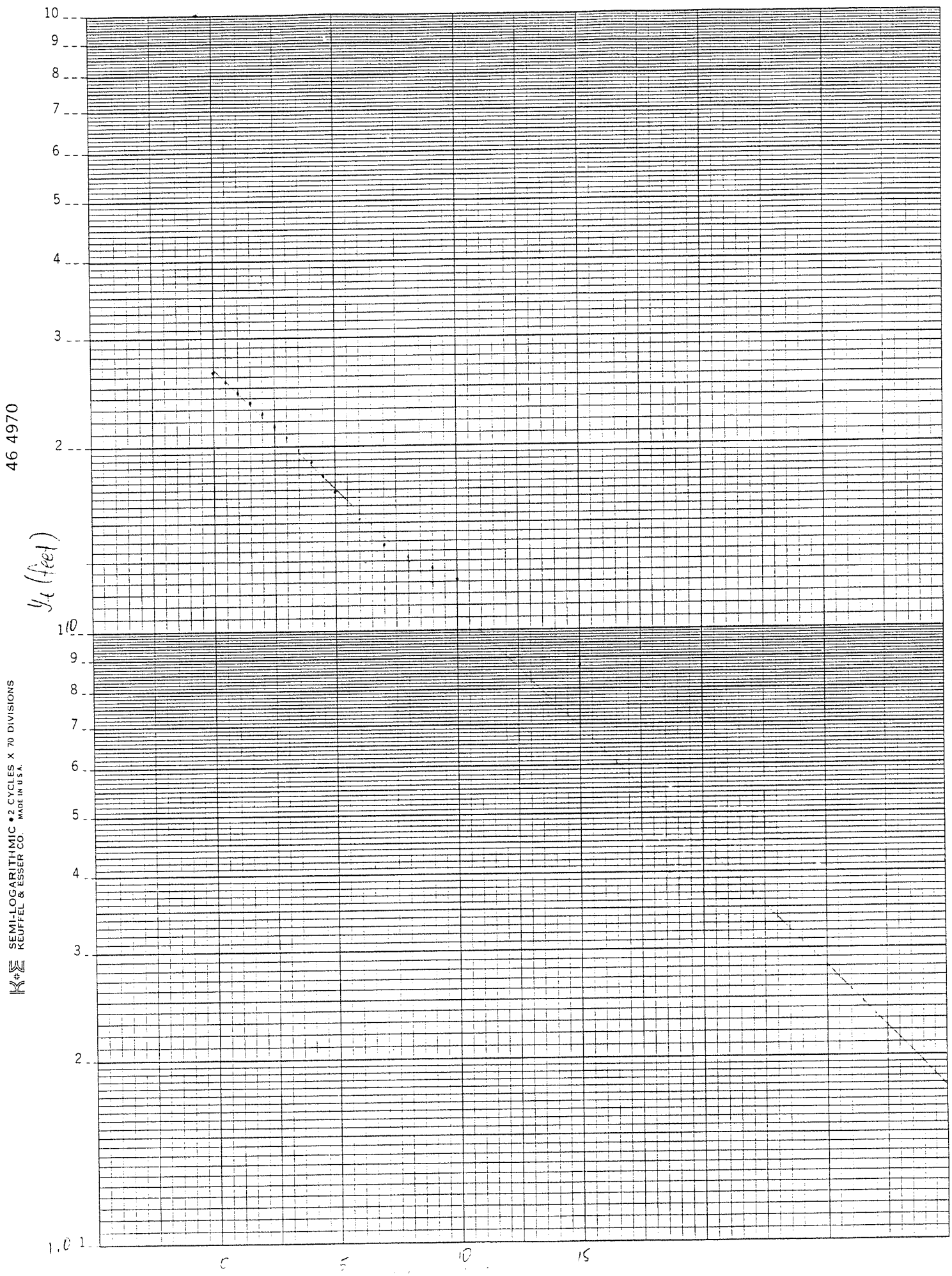
APPENDIX A
In-flow Permeability Calculations

BAIL TEST RECOVERY DATA
N. MECK. LANDFILL

MW-7, NOVEMBER 9, 1994

INITIAL DTW: 51.5

ELAPSED TIME (Min)	DEPTH TO WATER TABLE (feet)	MEASURED W.T. DEPTH MINUS EQUILIBRIUM W.T. DEPTH (feet)
0.00	77.55	26.45
0.25		
0.50	76.64	25.54
0.75		
1.00	75.66	24.56
1.25		
1.50	74.70	23.60
1.75		
2.00	73.85	22.75
2.50	72.87	21.77
3.00	71.98	20.88
3.50	70.89	19.79
4.00	69.91	18.81
4.50	68.97	17.87
5.00	68.01	16.91
5.50		
6.00	66.32	15.22
6.50		
7.00	64.87	13.77
7.50		
8.00	64.30	13.20
8.50		
9.00	63.76	12.66
9.50		
10.00	63.19	12.09
11.00		
12.00		
13.00		
14.00		
15.00	59.81	8.71
16.00		
17.00		
18.00		
19.00		
20.00		
25.00		
30.00		
35.00		
40.00		


10
9
8
7
6
5
4
3
2
1.0
1
2
3
4
5
6
7
8
9
10
0
5
10
15
y_t (feet)
46 4970
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KEUFFEL & ESSER CO. MADE IN U.S.A.

ESI COMPUTATION SHEET

PROJECT TITLE: N. MECK. LANDFILL — PROJECT NO. ES675
DESCRIPTION: IN-FLOW PERMEABILITY TEST MW-7 — SHEET ___ OF ___
PREPARED BY: ___ DATE: ___ CHK'D BY: ___ DATE: ___

BOUWER AND RICE METHOD

Variables

$Y_t = 13'$

$t = 8$ min

$Y_0 = 26.45'$

$L = 20'$

$r_c = 0.08'$

$r_w = 0.25'$

$L/r_w = 80$

$H = 31.5'$

$C = 3.5$

$\mu =$

Equations:

$$\ln R_e/r_w = \left(\frac{1.1}{\ln(31.5/0.25)} + \frac{3.5}{80} \right)^{-1}$$

$$\ln R_e/r_w = 3.69$$

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \cdot \frac{1}{t} \cdot \ln \frac{Y_0}{Y_t}$$

$$K = \frac{0.08^2 \ln(3.69)}{40} \cdot \frac{1}{8} \cdot \ln \frac{26.45}{13}$$

$$K = 1.85 \times 10^{-5} \text{ ft/min} = 9.42 \times 10^{-6} \text{ cm/sec.}$$

ESI ECOLOGICAL SERVICES, INC.
P. O. Box 12146
Charlotte, NC 28220
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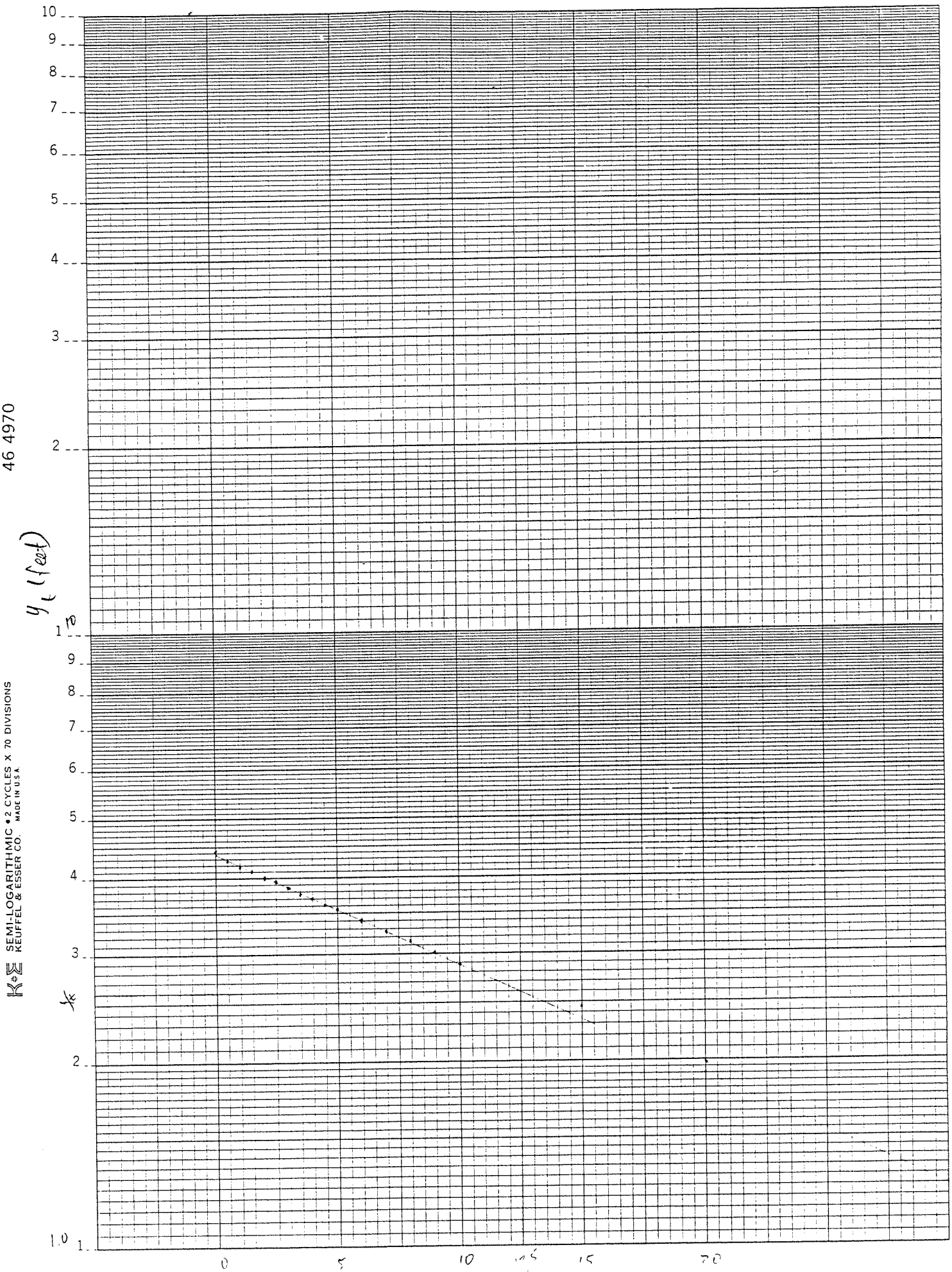
MW-4 NOV. 9,94


10
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8
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15
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y_t (feet)
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KEUFFEL & ESSER CO. MADE IN U.S.A.

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PROJECT TITLE: N. MEDL LANDFILL PROJECT NO. ES675
DESCRIPTION: IN-FLOW PERMEABILITY TEST MW-9 SHEET ___ OF ___
PREPARED BY: ___ DATE: ___ CHK'D BY: ___ DATE: ___

BOUWER AND RICE METHOD

Variables

$y_t = 2.6'$

$t = 12.5$ min

$y_o = 4.42$

$L = 20'$

$r_c = 0.08'$

$r_w = 0.25'$

$y_{rw} = 80$

$H = 3.42'$

$C = 3.5$

$K =$

Equations:

$$\ln Re/r_w = \left(\frac{1.1}{\ln(3.42/0.25)} + \frac{3.5}{80} \right)^{-1}$$

$$\ln Re/r_w = 2.15$$

$$K = \frac{r_c^2 \ln(Re/r_w)}{2L} \cdot \frac{1}{t} \ln \frac{y_o}{y_t}$$

$$K = \frac{0.08^2 \ln(2.15)}{40} \cdot \frac{1}{12.5} \ln \frac{4.42}{2.6}$$

$K = 5.20 \times 10^{-6}$ ft/min $= 2.64 \times 10^{-6}$ cm/sec

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BAIL TEST RECOVERY DATA
N. MECK. LANDFILL

MW-9, NOVEMBER 9, 1994

INITIAL DTW: 18.58

ELAPSED TIME (Min)	DEPTH TO WATER TABLE (feet)	MEASURED W.T. DEPTH MINUS EQUILIBRIUM W.T. DEPTH (feet)
0.00	23.00	4.42
0.25		
0.50	22.86	4.28
0.75		
1.00	22.75	4.17
1.25		
1.50	22.68	4.10
1.75		
2.00	22.60	4.02
2.50	22.52	3.94
3.00	22.43	3.85
3.50	22.34	3.76
4.00	22.28	3.70
4.50	22.19	3.61
5.00	22.11	3.53
5.50		
6.00	21.98	3.40
6.50		
7.00	21.86	3.28
7.50		
8.00	21.72	3.14
8.50		
9.00	21.59	3.01
9.50		
10.00	21.47	2.89
11.00		
12.00		
13.00		
14.00		
15.00	21.03	2.45
16.00		
17.00		
18.00		
19.00		
20.00	20.56	1.98
25.00		
30.00		
35.00		
40.00		

BAIL TEST RECOVERY DATA
N. MECK. LANDFILL

MW-10, NOVEMBER 9, 1994

INITIAL DTW: 10.55

ELAPSED TIME (Min)	DEPTH TO WATER TABLE (feet)	MEASURED W.T. DEPTH MINUS EQUILIBRIUM W.T. DEPTH (feet)
0.00	17.15	6.60
0.25		
0.50		
0.75		
1.00	15.92	5.37
1.25		
1.50		
1.75		
2.00	14.93	4.38
2.50	13.88	3.33
3.00	12.90	2.35
3.50	12.10	1.55
4.00	11.53	0.98
4.50	11.21	0.66
5.00	10.99	0.44
5.50		
6.00	10.89	0.34
6.50		
7.00	10.83	0.28
7.50		
8.00	10.79	0.24
8.50		
9.00	10.76	0.21
9.50		
10.00	10.72	0.17
11.00		
12.00		
13.00		
14.00		
15.00	10.58	0.03
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19.00		
20.00		
25.00		
30.00		
35.00		
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BOUWER AND RICE METHOD

Variables

$y_t = 1.25'$

$t = 3.75$ min

$y_o = .25$

$L = 10$

$r_c = 0.08$

$r_w = 0.25'$

$L/r_w = 40$

$H = 8.45$

$C = 2.75$

$k =$

Equations

$$\ln Re/r_w = \left(\frac{1.1}{\ln(8.45/0.25)} + \frac{2.75}{40} \right)^{-1}$$

$$\ln Re/r_w = 2.62$$

$$k = \frac{r_c^2 \ln(Re/r_w)}{2L} \cdot \frac{1}{t} \cdot \ln \frac{y_o}{y_t}$$

$$= \frac{0.08^2 \ln(2.62)}{20} \cdot \frac{1}{3.75} \cdot \ln \frac{.25}{1.25}$$

$$k = 1.56 \times 10^{-4} \text{ ft/min} = 7.92 \times 10^{-5} \text{ cm/sec}$$

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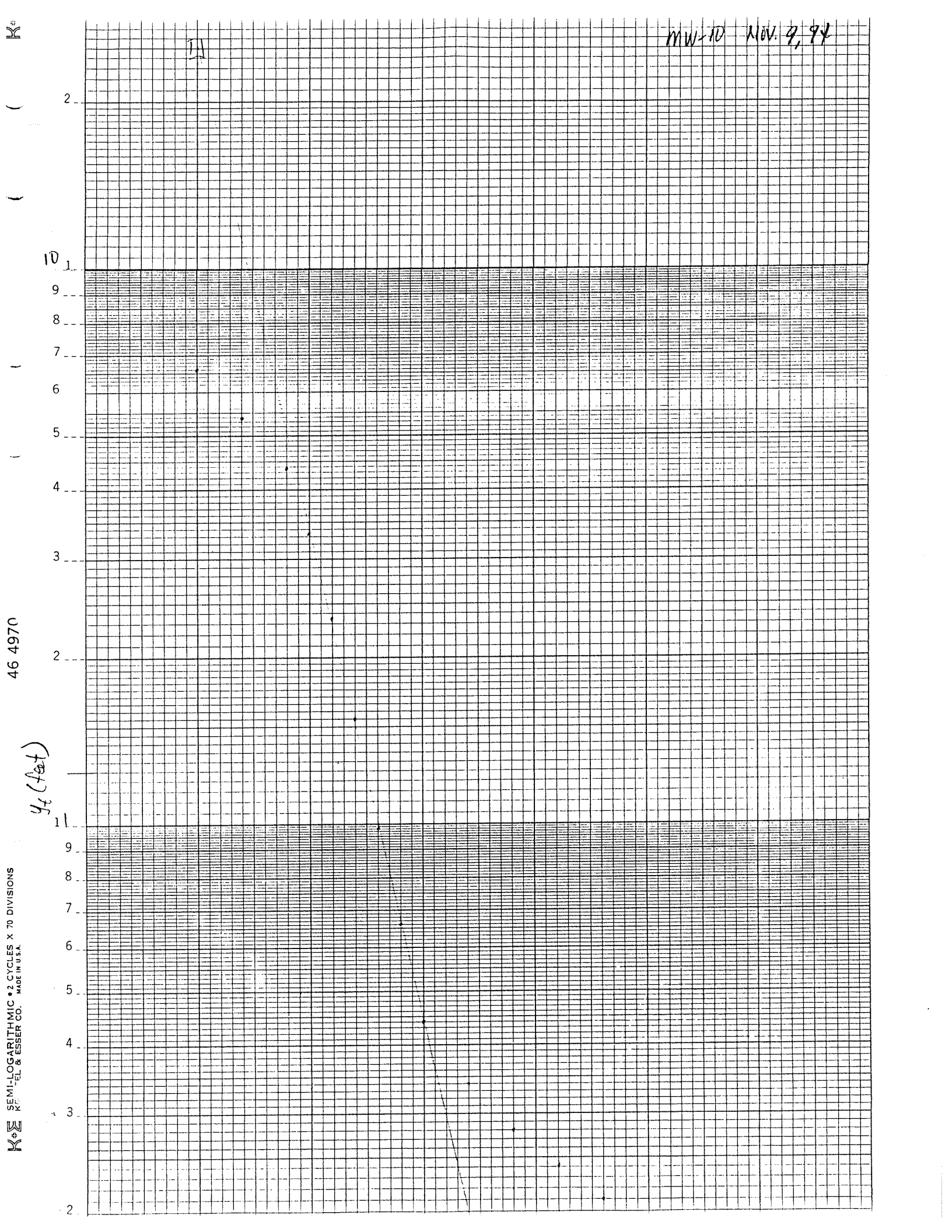
MW-10 NOV. 9, 94
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y_t (fat)
46 4970
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BAIL TEST RECOVERY DATA
N. MECK. LANDFILL

PZ–7, JULY 6, 1994

INITIAL DTW: 48.19

ELAPSED TIME (Min)	DEPTH TO WATER TABLE (feet)	MEASURED W.T. DEPTH MINUS EQUILIBRIUM W.T. DEPTH (feet)
0.00	58.30	10.11
0.25	58.17	9.98
0.50	58.05	9.86
0.75	57.91	9.72
1.00	57.77	9.58
1.25	57.63	9.44
1.50	57.52	9.33
1.75	57.38	9.19
2.00	57.26	9.07
2.50	57.00	8.81
3.00	56.75	8.56
3.50	56.46	8.27
4.00	56.22	8.03
4.50	55.99	7.80
5.00	55.76	7.57
5.50	55.52	7.33
6.00	55.32	7.13
6.50	55.08	6.89
7.00	54.85	6.66
7.50	54.64	6.45
8.00	54.43	6.24
8.50	54.22	6.03
9.00	54.02	5.83
9.50	53.86	5.67
10.00	53.70	5.51
11.00	53.49	5.30
12.00	53.24	5.05
13.00	53.04	4.85
14.00	52.76	4.57
15.00	52.48	4.29
16.00	52.25	4.06
17.00	52.03	3.84
18.00	51.80	3.61
19.00	51.62	3.43
20.00	51.45	3.26
25.00	50.86	2.67
30.00	50.33	2.14
35.00	49.95	1.76
40.00	49.63	1.44